Tutorial for Final exam EP 356.3, April 5th, 2003, Rm 126, 4 p.m.

No books, no notes, no calculators, formula sheet provided.

I strongly recommend starting this test without the book under the same conditions as the Final exam!

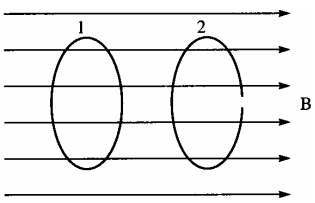
Solve all problems.

1. An infinitely long cylinder, of radius *R*, carries a "frozen-in" magnetization, parallel to the axis $\vec{M} = ks^2\vec{u}_z$
   where *k* is a constant and *s* is the distance from the axis. There is not free current anywhere. Find the magnetic field inside and outside the cylinder.

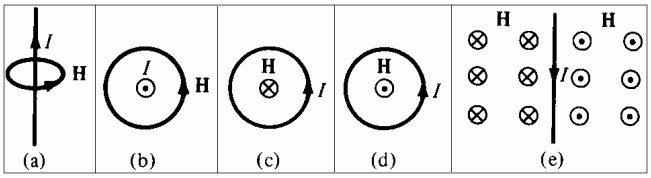
2. A long solenoid, of radius *a*, is driven by an alternating current, so that the field inside is sinusoidal: $\vec{B}(t) = B_0 \cos(\omega t)\vec{u}_z$
   A circular loop of wire, of radius *a/2* and resistance *R*, is placed inside the solenoid, and coaxial with it. Find the current induced in the loop, as a function of time.

3. Calculate the energy stored in a toroidal coil with rectangular cross section (inner radius *a*, outer radius *b*, height *h*), which carries a total of *N* turns.

4. Answer the following questions:
   a. Two conducting coils 1 and 2 (identical except that 2 is split) are placed in a uniform magnetic field, which decreases at a constant rate as in the Figure. If the planes of the coils are perpendicular to the field lines, which of the following statements is true? (I) An emf is induced in both coils. (II) An emf is induced in split coil 2. (III) Equal joule heating occurs in both coils. (IV) Joule heating does not occur in either coil.



   b. Identify the configuration in the Figure that is not a correct representation of *I* and $\vec{H}$.



   c. Which of the following are not sources of magnetostatic fields? (I) A dc current in a wire. (II) A permanent magnet. (III) An accelerated charge. (IV) An electric field linearly changing with time. (V) A charged disk rotating at uniform speed.